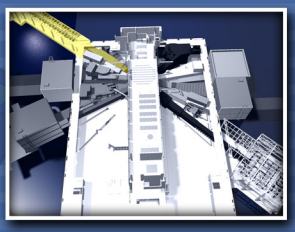
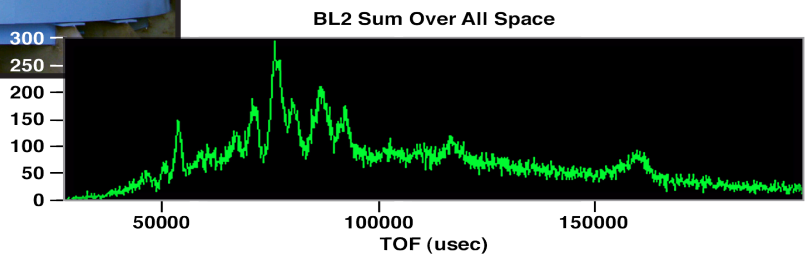
Instrument Fact Sheet

BEAM LINE 2



Backscattering Spectrometer

The backscattering spectrometer on beam line 2 is designed to provide extremely high-energy resolution near the elastic peak, enabling studies of the diffusive dynamics of molecules on the atomic length scale (quasielastic neutron scattering). This instrument features very high flux and a dynamic range in energy transfer that is approximately five times greater than what is available on comparable instruments today. In addition, the instrument provides the unique capability of shifting the incident neutron bandwidth, enabling inelastic scattering to 18 meV of energy transfer with a resolution of 0.1% of the energy transfer.



The first neutron diffraction peaks taken at SNS were of mica at the Backscattering Spectrometer; they are clearly visible after counting 118k neutrons.

Specifications

Si 111	
Elastic energy	2.08 meV
Bandwidth	±258 μeV
Resolution (elastic)	2.2 – 2.7 μeV
Q-range (elastic)	0.17 Å^{-1} < Q < 2.0 Å^{-1}
Solid angle	2.0 sr 4.0 sr (upgrade)

Si 311 (upgrade)	
Elastic energy	7.64 meV
Bandwidth	±1700 μeV
Resolution (elastic)	10 μeV
Q-range (elastic)	0.35 Å^{-1} < Q < 3.8 Å^{-1}
Solid angle	4.0 sr

Significant Events

- March 2006: Completed Instrument Readiness Review for low power operations.
- May 19, 2006: Backscattering Spectrometer received operational approval.
- May 23, 2006: The first diffraction pattern was measured from a 25g sample of fluorinated mica placed in a 3cm x 3cm neutron beam with a time averaged proton power on target of 185 watts. Four detector tubes counted for 822 seconds, making this instrument the first in recording time-of-flight data.
- May 31, 2006: The first energy transfer resolved spectrum was measured from a sample of 4-methyl pyridine N-oxide which exhibited the expected series of tunneling peaks.

Future Events

- Fall 2006: Initial users will arrive for experiments.
- Summer 2007: Power level to exceed 100kW.
- Fall 2007: General User Program for first three instruments opens.

For more information, contact Backscattering Spectrometer staff

Instrument Scientist: Ken Herwig, herwigkw@ornl.gov, (865) 576-5095
Instrument Scientist: Eugene Mamontov, mamontove@ornl.gov, (865) 574-5109
Scientific Associate: Stephanie Hammons, hammonsse@ornl.gov, (865) 300-8100

www.sns.gov/users/instrument_systems/instruments/inelastic/backscattering.shtml

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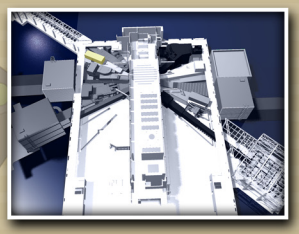
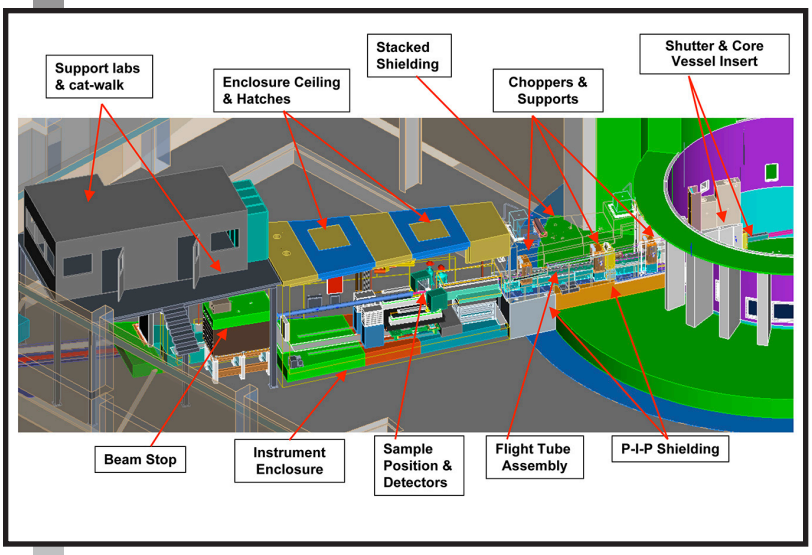
Instrument Fact Sheet

BEAM LINE 3



Spallation Neutrons and Pressure (SNAP)

The Spallation Neutrons and Pressure (SNAP) diffractometer will allow studies of a variety of powdered and single-crystal samples under extreme conditions of pressure and temperature. The increased neutron flux, coupled with large volume pressuring cells utilizing large synthetic single-crystal opposed anvils, will allow significant advances in the pressure range accessible to neutron diffraction. The pressure goal is 50-100 GPa on ~1 mm^3 sample on a routine basis. In addition, recent advances in next generation detectors will allow the inãdent beam focusing optics, pressure chamber, and detector array to be highly integrated, thus providing a highly flexible faãlity for materials studies under extreme conditions.



Specifications

Moderator	Decoupled poisoned Supercritical hydrogen
Beam line	3
Source-sample distance	15 m
Sample-detector distance	50 cm
Angular coverage	38-142° \ 98-150° horizontal ±34° vertical

Wavelength range (bandwidth)	
Frame 1	0.5 to 3.65 Å
Frame 2	3.7 to 6.5 Å

Pressure range	From ambient pressure to >50 GPa (500 kbar)
Focused beam size	From 1 cm to <100 microns

Recent Significant Events:

- Integrated design review: March 2006
- SNAP Instrument Development Team meeting: April 10-11, 2006

Future Events:

- Install detector frame with detectors: July 2007
- Receive delivery of pressure devices: January 2008
- Projected completion: Spring 2008
- Initial users begin: Summer 2008
- General users begin: Early 2009

For more information, contact the SNAP staff:

Instrument Sãentist: Chris Tulk, tulkca@ornl.gov, (865) 576.7028
Lead Engineer: Steve Chae, chaesm@ornl.gov, (865) 576.8180
Designer: Mark Phillips, phillipsm@ornl.gov, (865) 241.8107

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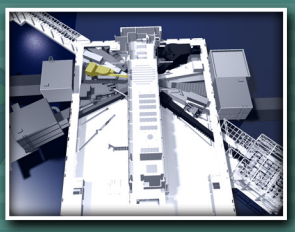
06-G00803/lmh

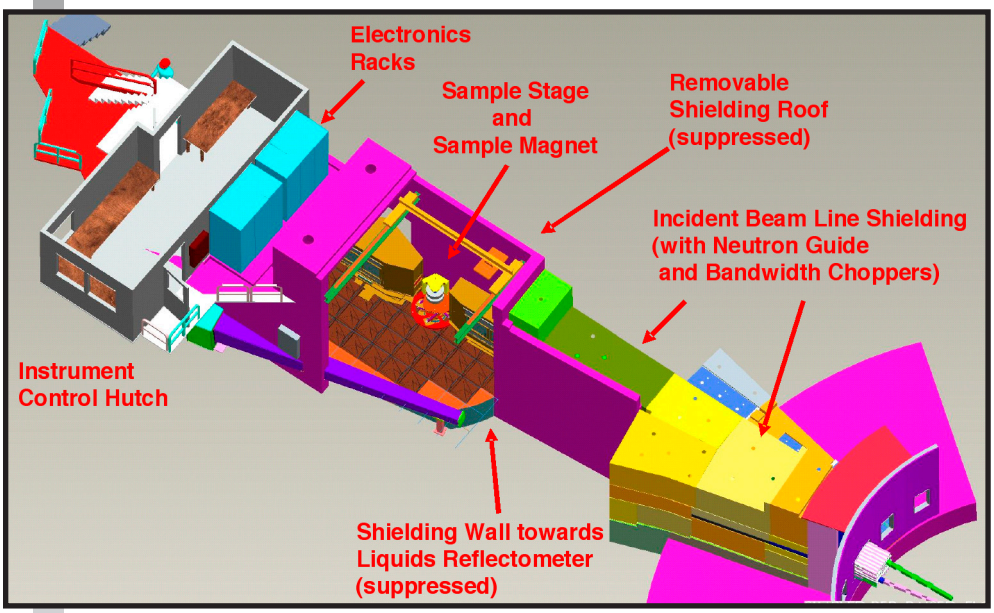
Instrument Fact Sheet

BEAM LINE 4A



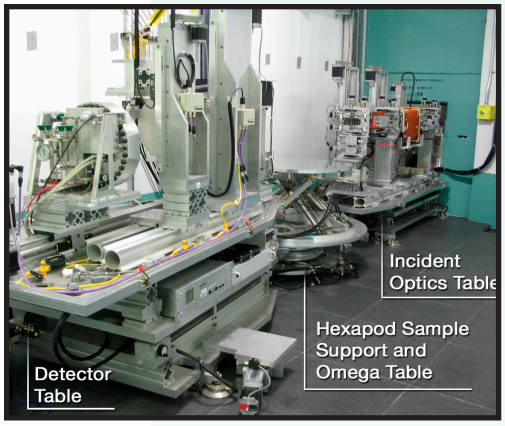
Magnetism Reflectometer

The magnetism reflectometer is designed for reflectometry and high-angle diffraction studies of magnetic thin films, superlattices, and surfaces. The combination of the high-power SNS neutron source and the use of advanced neutron optics will also allow off-specular diffraction studies of in-plane structures. Today, even at the world's most advanced neutron sources, such experiments are extremely difficult to perform. The availability of polarized neutrons and polarization analysis suggests that the instrument will also be used for specific studies of nonmagnetic thin-film samples. Examples for the latter case include contrast variation, incoherent background reduction, and phase determination for direct inversion of reflectivity data into real-space scattering-length density profiles.



Specifications

Source-sample distance	18.64 m
Sample-detector distance	0.5 – 6 m
Detector size	20 • 20 cm^2
Detector resolution	1.5 mm
Moderator	coupled supercritical hydrogen
Bandwidth	$\Delta\lambda$ = 3.1 Å
Wavelength range	1.8 Å < λ < 14.0 Å
Q range	0 $Å^{-1}$ < Q < 7.0 $Å^{-1}$
Minimum reflectivity	10^{-9} – 10^{-10}
Detector area	18 cm x 18 cm



Magnetism reflectometer

Recent Significant Events

Instrument Construction

- Instrument construction is complete.
- The instrument safety review was conducted on June 1, 2006.
- Commissioning will start in July 2006.

Instrument Science

- Outfitting of a lab for neutron polarization equipment is under way.
- A workshop on high-magnetic field science was held at the National High Magnetic Field Laboratory.

For more information, contact Magnetism Reflectometer staff

Instrument Scientist: Frank Klose, klosefr@sns.gov, (865) 576-5389
Lead Engineer: Tim Chae, chaet@sns.gov, (865) 241-6740
Electrical Engineer: Andre Parizzi, parizziad@sns.gov, (865) 576-6219
Scientific Associate: Richard J. Goyette Jr., goyetterj@sns.gov, (865) 241-9991

www.sns.gov/users/instrument_systems/instruments/elastic/magnet.shtml

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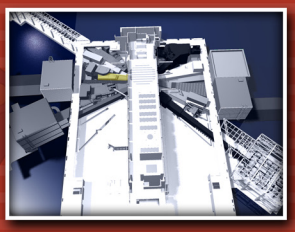
05-03085A/arm

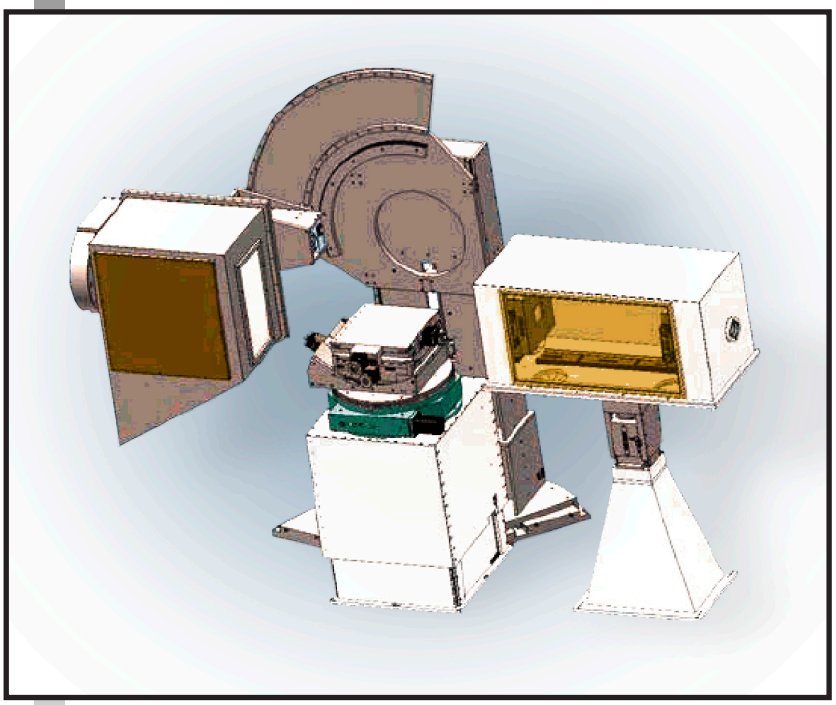
Instrument Fact Sheet

BEAM LINE 4B



Liquids Reflectometer

The liquids reflectometer features a horizontal sample geometry and so can accommodate air/liquid surfaces, in addition to air/solid and liquid/solid interfaces. Active vibration isolation minimizes capillary-wave production by the external environment. The instrument will be useful for a wide range of science, including interfacial studies of biomaterials, polymers, and chemistry involving thin layers of surfactants or other materials on the surfaces of liquids. Data rates and Q-range covered at a single scattering angle setting will be sufficiently high to permit "real-time" kinetic studies on many systems. Time-resolved experiments include investigations of chemical kinetics, solid-state reactions, phase transitions, and chemical reactions in general.



Specifications

Source-sample distance	13.6 m
Sample-detector distance	1.5 m
Detector size	20 • 20 cm^2
Detector resolution	1.3 × 1.3 mm^2
Moderator	coupled supercritical hydrogen
Bandwidth	$\Delta\lambda$ = 3.5 Å
Wavelength range	2.5 Å < λ < 17.5 Å
Q range (air/liquid)	0 $Å^{-1}$ < Q < 0.5 $Å^{-1}$
Q range (air/solid)	0 $Å^{-1}$ < Q < 1.5 $Å^{-1}$
Minimum reflectivity	5 x 10^{-10}

Recent Significant Events

Instrument Construction

- Instrument construction is complete.
- The instrument safety review was conducted on May 31, 2006.
- Commissioning will start in July 2006.

For more information, contact Liquids Reflectometer staff

Instrument Scientist: John Ankner, anknerjf@sns.gov, (865) 576-5122
Lead Engineer: Tim Chae, chaet@sns.gov, (865) 241-6740
Scientific Associate: Tammy McHargue, mchargueta@sns.gov, (865) 576-9036

www.sns.gov/users/instrument_systems/instruments/elastic/liquid.shtml

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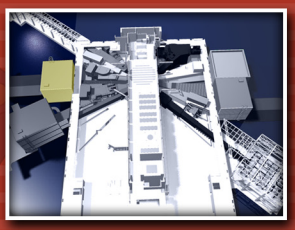
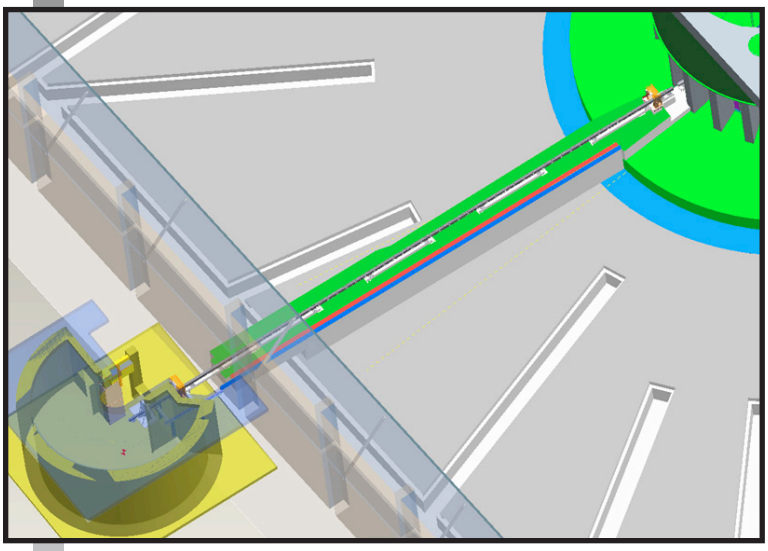
Instrument Fact Sheet

BEAM LINE 5



Cold Neutron Chopper Spectrometer

The Cold Neutron Chopper Spectrometer (CNCS) on beam line 5 is a high resolution, direct geometry, multi-chopper inelastic spectrometer designed to provide flexibility in the choice of energy resolution and to perform best at low incident energies (2-50 meV). Initially, the detector coverage around the sample is 1 sr, but a later upgrade to 3 sr is possible. CNCS experiments will typically use energy resolution between 10 and 500 μeV. A broad variety of scientific problems, ranging from complex and quantum fluids to magnetism and chemical spectroscopy, will be addressed through experiments on CNCS at SNS.

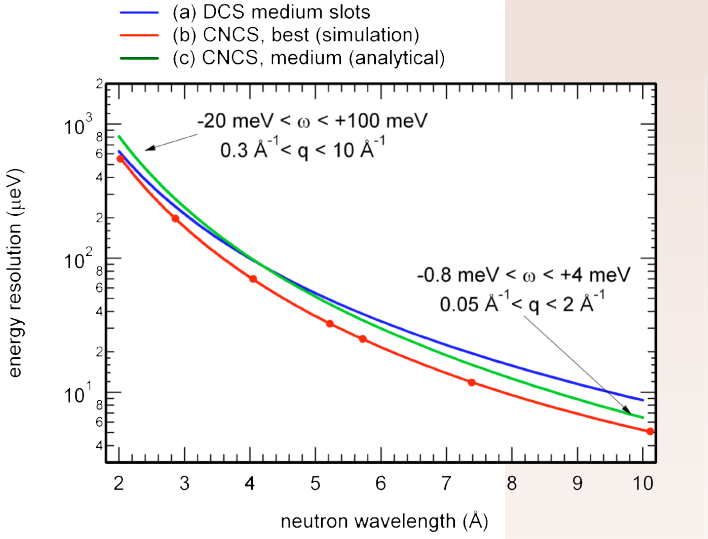


Specifications

Beam line	5
Source-sample distance	36.2 m
Sample-detector distance	3.5 m
Angular coverage	-90° … +140° horizontally; ±25 ° vertically
Energy resolution	10 μeV – 500 μeV
Incident energy range	2 – 50 meV
Momentum transfer range	0.05 – 10 Å $^{-1}$

Recent Significant Events:

- The secondary spectrometer will be housed in a satellite building, and the construction contract has been awarded.
- Groundbreaking for the instrument satellite building is scheduled to begin in early July, 2006.
- Key components, such as the neutron guide and one of the high-speed choppers, are expected to arrive at SNS later in 2006.



For more information, contact Cold Neutron Chopper Spectrometer staff:

Instrument Scientist: Georg Ehlers, ehlersg@ornl.gov, (865) 576.3511
Lead Engineer: David Prieto, prietodb@ornl.gov, (865) 241.6336
Scientific Associate: Chrissi Schnell, schnellca@ornl.gov

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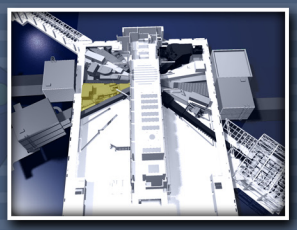
06-G00801/lmh

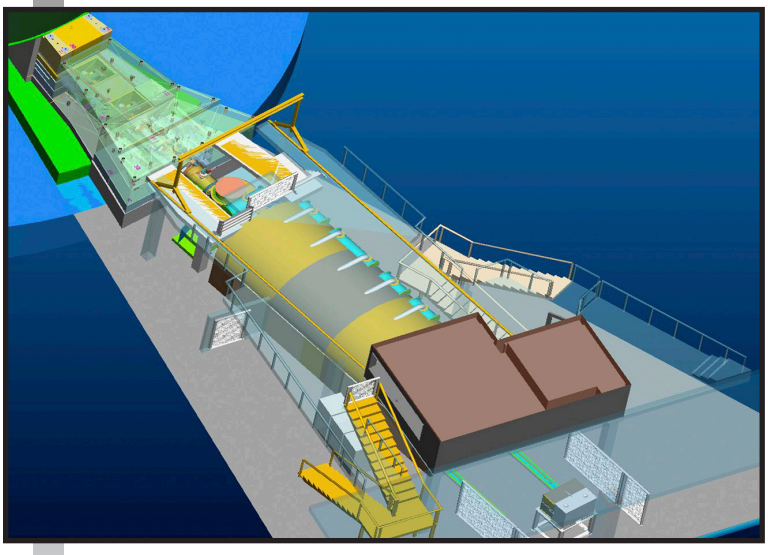
Instrument Fact Sheet

BEAM LINE 6



Extended Q-Range Small-Angle Scattering Diffractometer

The Extended Q-Range Small-Angle Scattering (EQ-SANS) Diffractometer is designed to study non-crystalline, nano-sized materials in solid, liquid, or gas forms such as polymers, proteins in solution, and micelles. EQ-SANS will have very high intensity and wavelength resolution. It will also have a wide Q coverage, allowing simultaneous data collection in both low and high Q regions. Scattering from nano-materials are concentrated mostly in a forward direction, or small angles. This scattering data will yield size and shape information of the nano-particles. Applications include the study of polymers, better detergents and soaps from improved micelles, the study of proteins for better drug design and in materials of interest to the oil industry.



Specifications

Source-sample distance	14 m
Bandwidth	3-4.3 Å
Moderator	coupled supercritical hydrogen
Integrated flux on sample	~10^7 – 10^9 n/cm^2/s
Q range	0.004 Å^{-1} < Q < 10 Å^{-1}

Low-angle detector	
Sample-detector distance	1 – 8 m
Detector size	1 m • 1 m
Detector resolution	8 mm

High-angle detector	
Sample-detector distance	1 m
Angular coverage	~35° – 150°
Detector resolution	8 mm

Recent Significant Events:

- SNS project Critical Decision-4 milestone has been achieved.
- All major design work is complete.
- Procurement of all baseline-funded components is under way.
- The first section of the guide is installed.
- Installation of poured-in-place shielding is under way.

Future Events:

- Summer 2007: Power level to exceed 100kW
- Fall 2007: Initial users will arrive for experiments
- Spring 2008: General User Program to open

For more information, contact EQ-SANS staff

Instrument Scientist: J.K. Zhao, zhaoj@sns.gov, (865) 574.0411
Lead Engineer: Randy Summers, summerspr1@ornl.gov, (865) 241.8285
Lead Engineer: Tim Chae, chaet@ornl.gov, (865) 241.6740
Scientific Associate: Hassina Bilheux, bilheuxhn@sns.gov, (865) 241.7534

www.sns.gov/users/instrument_systems/instruments/elastic/qrange.shtml

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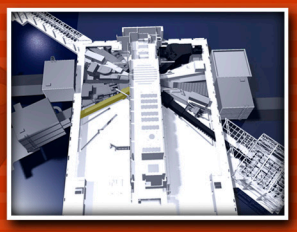
05-03084/arm

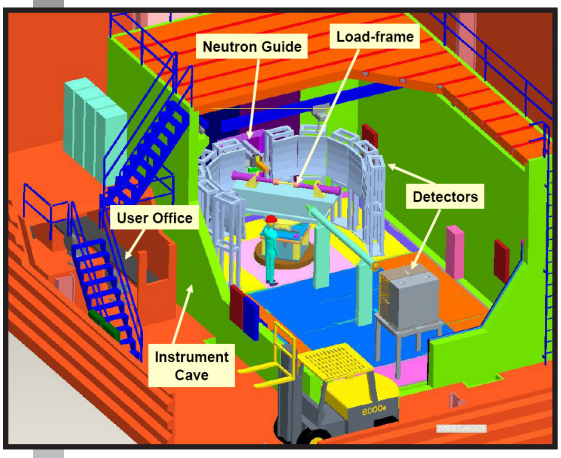
INSTRUMENT Fact Sheet

BEAM LINE 7



ENGINEERING MATERIALS DIFFRACTOMETER

The Engineering Materials Diffractometer, VULCAN, on beam line 7 will help users understand a broad range of engineering and material science problems. Characteristics of the instrument include stress mapping of engineering components with a 1 mm^3 sampling volume, in-situ loading with 10-20 reflections, and real-time studies of the kinetics of materials in sub-second time-scales. The basic design allows users to determine stress distribution in engineering components and to understand more about the deformation of materials under multi-axial loading. VULCAN will help scientists and engineers test the reliability of structural components and better understand how materials deform. The flux on sample will reach $1x10^8$ neutrons/cm^2/sec, providing a high intensity for fast kinetic studies. The instrument team plans to have a small angle detector to allow users to conduct simultaneous measurements of small angle scattering, thereby enabling studies of the evolution of material structures at multiple length scales. Major funding for the construction of VULCAN is provided by the Canada Foundation for Innovation (CFI). In addition, through the University of Tennessee (UT), the U.S. National Science Foundation Major Research Instrumentation Program funded the sample environment suite for VULCAN. The U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, provides further funding for completing the instrument.



RECENT SIGNIFICANT EVENTS:

- The contract for the external building has been awarded, and ground breaking is scheduled for mid-June, 2006.
- The instrument is scheduled to be commissioned in 2008.
- Major components for the instrument are being ordered, such as the neutron guides, double-disc chopper, sample positioner system, and detector.
- Studies of transient behaviors during welding have already been demonstrated; i.e. the in-situ study of friction and stir welding by Dr. Z. Feng, et al., ORNL.
- Working closely with UT on their NSF International Materials Institutes Program for "Advanced Neutron Scattering Network for Education and Research" (ANSWER) for community outreach
- Shutter and inserts have been installed
- Poured-in-place shielding has begun

SPECIFICATIONS

Beam line	7
Moderator	Decoupled poisoned water
Source-sample distance	43.5 m
Sample-detector distance	1.5 – 2 m
Detector angular coverage	$60^o < 2\theta < 150^o$
Wavelength bandwidth	~1.3 Å
Resolution	0.2% in high-resolution mode
Flux on sample (n/s/cm^2/Å)	$3x10^7$ in high-resolution mode $1.2x10^8$ in high-intensity mode
Gauge volume	3D strain mapping: 1 mm^3 1D strain mapping: 0.1 mm
SANS Q range ($Å^{-1}$)	0.01 – 0.2

CITATIONS:

X.-L. Wang, T.M. Holden, G.Q. Rennich, A.D. Soica, P.K. Liaw, H.Choo, and C.R. Hubbard. "VULCAN – The Engineering Diffractometer at the SNS," to appear in Physica B

X-L. Wang, "Applications of neutron diffraction to engineering problems," overview article in JOM, March, 53-58, 2006.

FOR MORE INFORMATION, CONTACT VULCAN STAFF:

Instrument Scientist: Xun-Li Wang, wangxl@ornl.gov, (865) 574-9164
Lead Engineer: George Rennich, rennichgq@ornl.gov, (865) 576-7520

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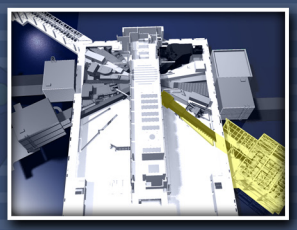
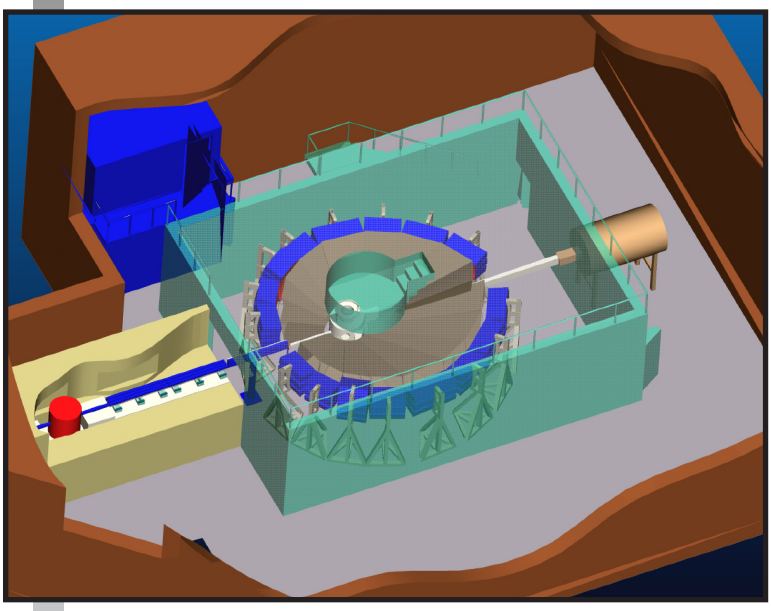
Instrument Fact Sheet

BEAM LINE 11A



POWGEN3 Powder Diffractometer

The POWGEN3 Powder Diffractometer is designed to study polycrystalline materials. It is a versatile diffractometer that enables users to collect typical Rietveld statistics in ~20 minutes from a 0.6cm3 sample with a <0.1% resolution at short d-spacings and <1% resolution for nearly all d-spacings of interest. This is a very standard tool with faster and higher precision than other diffractometers in the U.S. Scientific opportunities exists in both magnetic materials, such as high-Tc superconductors, metal-insulator transitions, charge and orbital ordering transitions, molecular magnets, and others; and non-magnetic materials such as Zeolite and AIPO frameworks, metals and semiconductors, dielectrics, ferroelectrics, and thermoelectrics, pharmaceuticals, and more.



Specifications

Moderator	decoupled poisoned supercritical hydrogen
Source-sample distance	60 m
Sample-detector distance	1 – 6 m
Detector angular coverage	6° < 2θ < 170°
Wavelength bandwidth	~1 Å
Frame 1	0.3 Å < d < 10 Å
Frame 6	3 Å < d < 66 Å
Resolution	0.001 < Δd/d < 0.016
Resolution at 90°	Δd/d = 0.0015

Recent Significant Events:

- The concrete shielding base, primary shutter, collimating shutter insert and bulk shield flange have all been installed.
- The first 40 m of the supermirror neutron guide have been delivered.
- Fabrication of the first two wavelength shifting crossed fiber detector modules has begun.
- Procurements have been placed for all instrument major components; including T0 chopper, three bandwidth choppers, concrete beamline shielding blocks, secondary shutter, sample vacuum chamber, helium filled coarse radial collimator, detector modules and stands, data acquisition system and computers, instrument shielding enclosure and beam stop.
- Instrument commissioning is expected mid-2007.

Future Events:

- Fall 2007: Initial users will arrive for experiments.
- Summer 2007: Power level to exceed 100kW.
- Spring 2008: General User Program opens for POWGEN3

For more information, contact Powder Diffractometer staff

Instrument Scientist: Jason Hodges, hodgesj@sns.gov, (865) 576.7034
Lead Engineer: Robert Whipple, whipplerz@sns.gov, (865) 241.1754
Scientific Associate: Luke Heroux, herouxla@sns.gov, (865) 241.8673

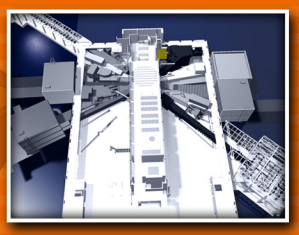
www.sns.gov/users/instrument_systems/instruments/elastic/pow-gen3.shtml

June 2006

05-03082/arm

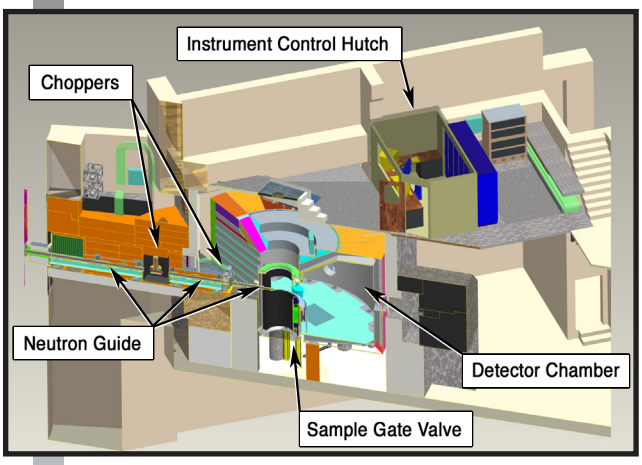
Instrument Fact Sheet

BEAM LINE 18



ARCS – Wide-angle Fermi Chopper Spectrometer

The wide Angular-Range Chopper Spectrometer (ARCS) on beamline 18 is optimized to provide a high neutron flux at the sample and a large solid angle of detector coverage. The spectrometer is capable of selecting incident energies over the full energy spectrum of neutrons, making it useful for studies of excitations from a few meV to several hundred meV. An elliptically-shaped supermirror guide in the incident flight path boosts the performance at the lower end of this range. The sample and detector vacuum chambers provide a window-free final flightpath, and incorporate a large gate valve to allow rapid sample changeout. A new T-zero neutron chopper is being developed to block not only the prompt radiation from the source, but also eliminate unwanted neutrons from the incident beamline. In addition to the instrument hardware, the ARCS project includes a significant effort for software development.



Cutaway view of the engineering model of the ARCS instrument showing the incident beamline components, sample and detector chamber, and control area.

Recent Significant Events:

Instrument Development

- A prototype single-crystal goniometer cooled to 10 K is operating at the Lujan Center, Los Alamos National Laboratory.
- A furnace optimized for inelastic neutron scattering is being tested at the Intense Pulsed Neutron Source, Argonne National Laboratory.
- ARCS software developed by the Instrument Development Team based at the California Institute of Technology is undergoing beta testing.
- Detector modules with integrated electronics for position sensitivity have been tested and are in production.

Instrument Construction

- Poured-in-place incident beamline shielding is installed.
- The sample chamber with gate valve is tested and being integrated with the detector chamber at the system manufacturer.
- The beamline guide sections and associated steel shielding before the T-zero chopper are installed.

Specifications

Moderator	Decoupled ambient water
Source – Fermi chopper distance	11.6 m
Chopper – sample distance	2.0 m
Sample – detector distance	3.0 m – 3.4 m cylindrical geometry
Incident energy range	10 – 1500 meV
Resolution (elastic)	2 – 5% E_i
Detector coverage horizontal	-28° – 135°
Detector coverage vertical	-27° – 26°
Minimum detector angle	3°

First section of neutron guide with steel shielding installed on Beamline 18.

For more information, contact the ARCS team:

Principal Investigator: Brent Fultz, Caltech, btf@caltech.edu, (626) 395.2170
Instrument Scientist: Doug Abernathy, abernathydl@sns.gov, (865) 576.5105
Lead Engineer: Kevin Shaw, shawkm@sns.gov, (865) 574.7628
Scientific Associate: Mark Loguillo, loguillomj@sns.gov, (865) 574.0961

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